

What is claimed is:

- 1 1. A method for efficient convolution, comprising the steps of:
 - 2 preparing a plurality of segmented perceptual response frequency spectra by
 - 3 removing high frequency components from a plurality of segmented response
 - 4 frequency spectra;
 - 5 generating a plurality of segmented input frequency spectra from a plurality of
 - 6 segmented input signals; and
 - 7 performing a frequency domain convolution method to generate convoluted signals
 - 8 using said plurality of segmented perceptual response frequency spectra and said
 - 9 plurality of segmented input frequency spectra;
 - 10 wherein said plurality of segmented perceptual response frequency spectra are
 - 11 generated by removing high frequency components from said plurality of segmented
 - 12 response frequency spectra based on a threshold.
- 1 2. The method for efficient convolution as claimed in claim 1, wherein said efficient
- 2 convolution is used for generating artificial room reverberation and said threshold is
- 3 based on a threshold in quiet, said threshold being determined by the minimum
- 4 amount of energy in a pure tone detected by a human hearing system in a noiseless
- 5 environment.
- 1 3. The method for efficient convolution as claimed in claim 1, wherein said frequency
- 2 domain convolution method is an overlap-and-add method by using FFT.
- 1 4. The method for generating efficient convolution as claimed in claim 1, wherein said
- 2 frequency domain convolution method is an overlap-and-save method by using FFT.

1 5. The method for efficient convolution as claimed in claim 1, wherein said segmented
 2 input signals have a segment size for segmentation and in the step of performing a
 3 frequency domain convolution method to generate convoluted signals, first and
 4 second segments of convoluted signals are generated by convolution using a block
 5 size smaller than the segment size.

1 6. A method for efficient convolution, comprising the steps of:

2 preparing an impulse response $h[n]$;

3 segmenting said impulse response into M segmented impulse responses $h_s[n]$,

4 wherein $h_s[n] = \begin{cases} h[n + sN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, s = 0, 1, 2, \dots, M-1;$

5 transforming said M segmented impulse responses $h_s[n]$ by DFT to form M

6 segmented frequency spectra $H_s[k]$ with $0 \leq k < 2N$;

7 removing high frequency components from said M segmented frequency spectra $H_s[k]$

8 based on a threshold to form M sets of segmented perceptual response frequency

9 spectra $H'_s[k]$;

10 receiving and segmenting an input signal $x[n]$ into a plurality of segmented input

11 signals $x_r[n]$, wherein $x_r[n] = \begin{cases} x[n + rN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, r = 0, 1, 2, \dots, \infty;$

12 transforming each segmented input signal $x_r[n]$ by DFT to form a segmented input

13 frequency spectrum $X_r[k]$;

14 multiplying said segmented input frequency spectrum $X_r[k]$ with said M sets of

15 segmented perceptual response frequency spectra $H'_s[k]$ for $s = 0, 1, 2, \dots, M-1$ to

16 form M segmented output frequency spectra $Y_{r,s}[k] = X_r[k] \cdot H'_s[k]$;

17 inverse transforming said M output frequency spectra $Y_{r,s}[k]$ to form M segmented
 18 output signals $y_{r,s}[n]$; and
 19 performing overlap-and-add summation of said M segmented output signals $y_{r,s}[n]$ to
 20 form a final output signal $y[n]$ according to

$$21 \quad y[n] = \sum_{r=0}^{\infty} \sum_{s=0}^{M-1} y_{r,s}[n - rN - sN].$$

1 7. The method for efficient convolution according to claim 6, wherein said impulse
 2 response has a length L and $M = \left\lceil \frac{L}{N} \right\rceil$ is a smallest integer larger than L divided by
 3 N .

1 8. A method for efficient convolution, comprising the steps of:

2 preparing an impulse response $h[n]$;

3 segmenting said impulse response into M segmented impulse responses $h_s[n]$,

4 wherein $h_s[n] = \begin{cases} h[n + sN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, s = 0, 1, 2, \dots, M-1;$

5 transforming said M segmented impulse responses $h_s[n]$ by DFT to form M
 6 segmented frequency spectra $H_s[k]$ with $0 \leq k < 2N$;

7 removing high frequency components from said M segmented frequency spectra $H_s[k]$
 8 based on a threshold to form M sets of segmented perceptual response frequency
 9 spectra $H'_s[k]$;

10 receiving and segmenting an input signal $x[n]$ into a plurality of segmented input
 11 signals $x_r[n]$, wherein $x_r[n] = \begin{cases} x[n + rN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, r = 0, 1, 2, \dots, \infty;$

12 transforming each segmented input signal $x_r[n]$ by FFT to form a segmented input

frequency spectrum $X_r[k]$;
buffering said segmented input frequency spectrum to form buffered segmented input
frequency spectra $X_{p-s}[k]$ for $s = 0, 1, 2, \dots, M$ and $p = 0, 1, 2, \dots, \infty$;
multiplying said M sets of segmented perceptual response frequency spectra $H'_s[k]$
with last buffered M segmented input frequency spectra $X_{p-s}[k]$ to form products $X_{p-s}[k] \cdot H'_s[k]$ for $s = 0, 1, 2, \dots, M-1$ and adding said products together to form a
segmented output frequency spectrum

$$Y_p[k] = \sum_{s=0}^{M-1} X_{p-s}[k] H'_s[k], \text{ for } 0 \leq k < 2N-1;$$

inverse transforming said segmented output frequency spectrum $Y_p[k]$ to form
segmented output signals $y_p[n]$; and
performing overlap-and-add summation of said M segmented output signals $y_p[n]$ to
form a final output signal $y[n]$ according to

$$y[n] = \sum_{p=s}^{\infty} y_p[n].$$

9. The method for efficient convolution according to claim 8, wherein said impulse
response has a length L and $M = \left\lceil \frac{L}{N} \right\rceil$ is a smallest integer larger than L divided by
 N .

10. A method for efficient convolution, comprising the steps of:

preparing an impulse response $h[n]$ of ;
segmenting said impulse response into M segmented impulse responses $h_s[n]$,

$$\text{wherein } h_s[n] = \begin{cases} h[n + sN], & 0 \leq n \leq N-1 \\ 0, & \text{otherwise} \end{cases}, s = 0, 1, 2, \dots, M-1;$$

5 transforming said segmented impulse responses $h_s[n]$ by DFT to form M segmented
 6 frequency spectra $H_s[k]$ with $0 \leq k < 2N$;
 7 removing high frequency components from said segmented frequency spectra $H_s[k]$
 8 based on a threshold to form M sets of segmented perceptual response frequency
 9 spectra $H'_s[k]$;
 10 receiving and segmenting an input signal $x[n]$ into a plurality of segmented input
 11 signals $x_r[n]$, wherein $x_r[n] = \begin{cases} x[n + rN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, r = 0, 1, 2, \dots, \infty$;
 12 overlapping and adding adjacent segmented input signals to form a plurality of
 13 overlapped-and-segmented input signals $x'_p[n] = x_{p-1}[n + N] + x_p[n]$, wherein –
 14 $N \leq n \leq N - 1$ and $p = 0, 1, 2, \dots, \infty$;
 15 transforming each overlapped-and-segmented input signal $x'_p[n]$ by FFT to form a
 16 segmented input frequency spectrum $X'_p[k]$;
 17 buffering said segmented input frequency spectrum to form buffered segmented input
 18 frequency spectra $X'_{p-s}[k]$ for $s = 0, 1, 2, \dots, M$ and $p = 0, 1, 2, \dots, \infty$;
 19 multiplying said M sets of segmented perceptual response frequency spectra $H'_s[k]$
 20 with last buffered M segmented input frequency spectra $X'_{p-s}[k]$ to form products $X'_{p-s}[k] \cdot H'_s[k]$
 21 for $s = 0, 1, 2, \dots, M-1$ and adding said products together to form a
 22 segmented output frequency spectrum

$$Y_p[k] = \sum_{s=0}^{M-1} X'_{p-s}[k] H'_s[k], \text{ for } 0 \leq k < 2N-1;$$

24 inverse transforming said segmented output frequency spectrum $Y_p[k]$ to form
 25 segmented output signals $y_p[n]$; and
 26 generating a final output signal $y[n]$ by discarding first N samples of $y_p[n]$.

- 1 11. The method for efficient convolution according to claim 10, wherein said impulse
2 response has a length L and $M = \left\lceil \frac{L}{N} \right\rceil$ is a smallest integer larger than L divided by
3 N .
- 1 12. An apparatus for efficient convolution, comprising:
2 a plurality of perceptual sparse processing units for removing high frequency
3 components from a plurality of segmented response frequency spectra to form a
4 plurality of segmented perceptual response frequency spectra; and
5 a FIR-filter receiving said plurality of segmented perceptual response frequency
6 spectra;
7 wherein each of said perceptual sparse processing units removes high frequency
8 components from a segmented response frequency spectrum based on a threshold.
- 1 13. The apparatus for efficient convolution as claimed in claim 12, wherein said FIR filter
2 is implemented by a frequency domain convolution method based on an overlap-and-
3 add method.
- 1 14. The apparatus for efficient convolution as claimed in claim 12, wherein said FIR-
2 filter is implemented by a frequency domain convolution method based on an
3 overlap-and-save method.
- 1 15. The apparatus for efficient convolution as claimed in claim 12, wherein said FIR-
2 filter comprises a first section in which frequency domain convolution is computed
3 with a first block size for reducing latency and a second section in which frequency
4 domain convolution is computed with a second block size.

1 16. An apparatus for efficient convolution, comprising:
2 a segmenting unit for segmenting an input signal into segmented input signals;
3 a FFT processor for performing fast Fourier transform on each segmented input signal
4 to a segmented input frequency spectrum;
5 a plurality of perceptual sparse processing units for removing high frequency
6 components from a plurality of segmented response frequency spectra to form a
7 plurality of segmented perceptual response frequency spectra;
8 a plurality of memory devices for storing said plurality of segmented perceptual
9 response frequency spectra;
10 a plurality of multipliers for multiplying said segmented input frequency spectrum
11 with said plurality of segmented perceptual response frequency spectra to form a
12 plurality of segmented output frequency spectra;
13 a plurality of IFFT processors for performing inverse fast Fourier transform on said
14 plurality of segmented output frequency spectra to form a plurality of segmented
15 output signals; and
16 a plurality of overlap-and-add units for overlapping and adding said plurality of
17 segmented output signals to form a final output signal;
18 wherein each of said perceptual sparse processing units removes high frequency
19 components from a segmented response frequency spectrum based on a threshold.

1 17. An apparatus for efficient convolution, comprising:

2 a segmenting unit for segmenting an input signal into segmented input signals;

3 a FFT processor for performing fast Fourier transform on each segmented input signal
4 to a segmented input frequency spectrum;
5 a plurality of perceptual sparse processing units for removing high frequency
6 components from a plurality of segmented response frequency spectra to form a
7 plurality of segmented perceptual response frequency spectra;
8 a plurality of memory devices for storing said plurality of segmented perceptual
9 response frequency spectra;
10 a plurality of buffers for buffering a plurality of segmented input frequency spectra;
11 a plurality of multipliers for multiplying said buffered plurality of segmented input
12 frequency spectra with said plurality of segmented perceptual response frequency
13 spectra to form a plurality of segmented output frequency spectra;
14 a summation unit for adding said plurality of segmented output frequency spectra to
15 form an output frequency spectrum;
16 an IFFT processor for performing inverse fast Fourier transform on said output
17 frequency spectrum to form an output signal; and
18 an overlap-and-add unit for overlapping and adding said output signal to form a final
19 output signal;
20 wherein each of said perceptual sparse processing units removes high frequency
21 components from a segmented response frequency spectrum based on a threshold .

1 18. An apparatus for efficient convolution, comprising:

2 an overlapping and segmenting unit for overlapping and segmenting an input signal

3 into overlapped-and-segmented input signals;
4 a FFT processor for performing fast Fourier transform on each overlapped-and-
5 segmented input signal to a segmented input frequency spectrum;
6 a plurality of perceptual sparse processing units for removing high frequency
7 components from a plurality of segmented response frequency spectra to form a
8 plurality of segmented perceptual response frequency spectra;
9 a plurality of memory devices for storing said plurality of segmented perceptual
10 response frequency spectra;
11 a plurality of buffers for buffering a plurality of segmented input frequency spectra;
12 a plurality of multipliers for multiplying said buffered plurality of segmented input
13 frequency spectra with said plurality of segmented perceptual response frequency
14 spectra to form a plurality of segmented output frequency spectra;
15 a summation unit for adding said plurality of segmented output frequency spectra to
16 form an output frequency spectrum;
17 an IFFT processor for performing inverse fast Fourier transform on said output
18 frequency spectrum to form an output signal; and
19 a discarding unit for discarding a number of samples from said output signal to form a
20 final output signal;
21 wherein each of said perceptual sparse processing units removes high frequency
22 components from a segmented response frequency spectrum based on a threshold.

1 19. A method for efficient convolution, comprising the steps of:

2 preparing a plurality of segmented response frequency spectra;
3 generating a plurality of segmented input frequency spectra from a plurality of
4 segmented input signals;
5 removing high frequency components from said plurality of segmented input
6 frequency spectra to form a plurality of segmented perceptual input frequency spectra;
7 and
8 performing a frequency domain convolution method to generate convoluted signals
9 using said plurality of segmented response frequency spectra and said plurality of
10 segmented perceptual input frequency spectra;
11 wherein said plurality of segmented perceptual input frequency spectra are generated
12 by removing high frequency components from said plurality of segmented input
13 frequency spectra based a threshold.

1 20. The method for efficient convolution as claimed in claim 19, wherein said efficient
2 convolution is used for generating artificial room reverberation and said threshold is
3 based on a threshold in quiet, said threshold being determined by the minimum
4 amount of energy in a pure tone detected by a human hearing system in a noiseless
5 environment.

1 21. The method for efficient convolution as claimed in claim 19, wherein said frequency
2 domain convolution method is an overlap-and-add method by using FFT.

1 22. The method for generating efficient convolution as claimed in claim 1, wherein said
2 frequency domain convolution method is an overlap-and-save method by using FFT.

1 23. The method for efficient convolution as claimed in claim 19, wherein said segmented

2 input signals have a segment size for segmentation and in the step of performing a
 3 frequency domain convolution method to generate convoluted signals, first and
 4 second segments of convoluted signals are generated by convolution using a block
 5 size smaller than the segment size.

1 24. A method for efficient convolution, comprising the steps of:

2 preparing an impulse response $h[n]$;

3 segmenting said impulse response into M segmented impulse responses $h_s[n]$,

4 wherein $h_s[n] = \begin{cases} h[n + sN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, s = 0, 1, 2, \dots, M-1;$

5 transforming said M segmented impulse responses $h_s[n]$ by DFT to form M

6 segmented response frequency spectra $H_s[k]$ with $0 \leq k < 2N$;

7 receiving and segmenting an input signal $x[n]$ into a plurality of segmented input

8 signals $x_r[n]$, wherein $x_r[n] = \begin{cases} x[n + rN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, r = 0, 1, 2, \dots, \infty;$

9 transforming each segmented input signal $x_r[n]$ by DFT to form a segmented input

10 frequency spectrum $X_r[k]$;

11 removing high frequency components from said segmented input frequency spectra

12 $X_r[k]$ based on a threshold to a segmented perceptual input frequency spectra $X'_r[k]$;

13 multiplying said segmented perceptual input frequency spectrum $X'_r[k]$ with said M

14 sets of segmented response frequency spectra $H_s[k]$ for $s = 0, 1, 2, \dots, M-1$ to form M

15 segmented output frequency spectra $Y_{r,s}[k] = X'_r[k] \cdot H_s[k]$;

16 inverse transforming said M output frequency spectra $Y_{r,s}[k]$ to form M segmented

17 output signals $y_{r,s}[n]$; and

18 performing overlap-and-add summation of said M segmented output signals $y_{r,s}[n]$ to

form a final output signal $y[n]$ according to

$$y[n] = \sum_{r=0}^{\infty} \sum_{s=0}^{M-1} y_{r,s}[n - rN - sN].$$

25. The method for efficient convolution according to claim 24, wherein said impulse response has a length L and $M = \left\lceil \frac{L}{N} \right\rceil$ is a smallest integer larger than L divided by N .

26. A method for efficient convolution, comprising the steps of:

preparing an impulse response $h[n]$;

segmenting said impulse response into M segmented impulse responses $h_s[n]$,

wherein $h_s[n] = \begin{cases} h[n + sN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, s = 0, 1, 2, \dots, M-1;$

transforming said M segmented impulse responses $h_s[n]$ by DFT to form M segmented response frequency spectra $H_s[k]$ with $0 \leq k < 2N$;

receiving and segmenting an input signal $x[n]$ into a plurality of segmented input

signals $x_r[n]$, wherein $x_r[n] = \begin{cases} x[n + rN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, r = 0, 1, 2, \dots, \infty;$

transforming each segmented input signal $x_r[n]$ by FFT to form a segmented input frequency spectrum $X_r[k]$;

removing high frequency components from said segmented input frequency spectrum $X_r[k]$ based on a threshold to form a segmented perceptual input frequency spectrum $X'_r[k]$;

buffering said segmented perceptual input frequency spectrum to form buffered segmented perceptual input frequency spectra $X'_{p-s}[k]$ for $s = 0, 1, 2, \dots, M$ and $p = 0,$

16 1, 2, ..., ∞ ;
 17 multiplying said M sets of segmented response frequency spectra $H_s[k]$ with last
 18 buffered M segmented perceptual input frequency spectra $X'_{p-s}[k]$ to form products
 19 $X'_{p-s}[k] \cdot H_s[k]$ for $s = 0, 1, 2, \dots, M-1$ and adding said products together to form a
 20 segmented output frequency spectrum

$$21 \quad Y_p[k] = \sum_{s=0}^{M-1} X'_{p-s}[k] H_s[k], \text{ for } 0 \leq k < 2N-1;$$

22 inverse transforming said segmented output frequency spectrum $Y_p[k]$ to form
 23 segmented output signals $y_p[n]$; and
 24 performing overlap-and-add summation of said M segmented output signals $y_p[n]$ to
 25 form a final output signal $y[n]$ according to

$$26 \quad y[n] = \sum_{p=s}^{\infty} y_p[n].$$

1 27. The method for efficient convolution according to claim 26, wherein said impulse
 2 response has a length L and $M = \left\lceil \frac{L}{N} \right\rceil$ is a smallest integer larger than L divided by
 3 N .

1 28. A method for efficient convolution, comprising the steps of:

2 preparing an impulse response $h[n]$ of ;

3 segmenting said impulse response into M segmented impulse responses $h_s[n]$,

$$4 \quad \text{wherein } h_s[n] = \begin{cases} h[n + sN], & 0 \leq n \leq N-1 \\ 0, & \text{otherwise} \end{cases}, s = 0, 1, 2, \dots, M-1;$$

5 transforming said segmented impulse responses $h_s[n]$ by DFT to form M segmented
 6 response frequency spectra $H_s[k]$ with $0 \leq k < 2N$;

7 receiving and segmenting an input signal $x[n]$ into a plurality of segmented input

8 signals $x_r[n]$, wherein $x_r[n] = \begin{cases} x[n + rN], & 0 \leq n \leq N - 1 \\ 0, & \text{otherwise} \end{cases}, r = 0, 1, 2, \dots, \infty;$

9 overlapping and adding adjacent segmented input signals to form a plurality of

10 overlapped-and-segmented input signals $x'_p[n] = x_{p-1}[n + N] + x_p[n], -N \leq n \leq$
11 $N - 1;$

12 transforming each overlapped-and-segmented input signal $x'_p[n]$ by FFT to form a
13 segmented input frequency spectrum $X'_p[k];$

14 removing high frequency components from said segmented input frequency spectrum
15 $X'_p[k]$ based on a threshold to form a segmented perceptual input frequency spectrum
16 $X''_p[k];$

17 buffering said segmented perceptual input frequency spectrum to form buffered
18 segmented perceptual input frequency spectra $X''_{p-s}[k]$ for $s = 0, 1, 2, \dots, M$ and $p = 0,$
19 $1, 2, \dots, \infty;$

20 multiplying said M sets of segmented response frequency spectra $H_s[k]$ with last
21 buffered M segmented perceptual input frequency spectra $X''_{p-s}[k]$ to form products
22 $X''_{p-s}[k] \cdot H_s[k]$ for $s = 0, 1, 2, \dots, M-1$ and adding said products together to form a
23 segmented output frequency spectrum

24
$$Y_p[k] = \sum_{s=0}^{M-1} X''_{p-s}[k] H_s[k], \text{ for } 0 \leq k < 2N-1;$$

25 inverse transforming said segmented output frequency spectrum $Y_p[k]$ to form
26 segmented output signals $y_p[n];$ and

27 generating a final output signal $y[n]$ by discarding first N samples of $y_p[n].$

1 29. The method for efficient convolution according to claim 28, wherein said impulse
2 response has a length L and $M = \left\lceil \frac{L}{N} \right\rceil$ is a smallest integer larger than L divided by
3 N .

1 30. An apparatus for efficient convolution, comprising:

2 a segmenting unit for segmenting an input signal into segmented input signals;

3 a FFT processor for performing fast Fourier transform on each segmented input signal
4 to a segmented input frequency spectrum;

5 a perceptual sparse processing unit for removing high frequency components from
6 said segmented input frequency spectrum to form a segmented perceptual input
7 frequency spectrum;

8 a plurality of memory devices for storing a plurality of segmented response frequency
9 spectra;

10 a plurality of multipliers for multiplying said segmented perceptual input frequency
11 spectrum with said plurality of segmented response frequency spectra to form a
12 plurality of segmented output frequency spectra;

13 a plurality of IFFT processors for performing inverse fast Fourier transform on said
14 plurality of segmented output frequency spectra to form a plurality of segmented
15 output signals; and

16 a plurality of overlap-and-add units for overlapping and adding said plurality of
17 segmented output signals to form a final output signal;

18 wherein said perceptual sparse processing unit removes high frequency components

19 from said segmented input frequency spectrum based on a threshold.

1 31. An apparatus for efficient convolution, comprising:

2 a segmenting unit for segmenting an input signal into segmented input signals;

3 a FFT processor for performing fast Fourier transform on each segmented input signal
4 to a segmented input frequency spectrum;

5 a perceptual sparse processing unit for removing high frequency components from
6 said segmented input frequency spectrum to form a segmented perceptual input
7 frequency spectrum;

8 a plurality of memory devices for storing a plurality of segmented response frequency
9 spectra;

10 a plurality of buffers for buffering a plurality of said segmented perceptual input
11 frequency spectra;

12 a plurality of multipliers for multiplying said buffered plurality of segmented
13 perceptual input frequency spectra with said plurality of segmented response
14 frequency spectra to form a plurality of segmented output frequency spectra;

15 a summation unit for adding said plurality of segmented output frequency spectra to
16 form an output frequency spectrum;

17 an IFFT processor for performing inverse fast Fourier transform on said output
18 frequency spectrum to form an output signal; and

19 an overlap-and-add unit for overlapping and adding said output signal to form a final
20 output signal;

21 wherein said perceptual sparse processing unit removes high frequency components
22 from said segmented input frequency spectrum based on a threshold.

1 32. An apparatus for efficient convolution, comprising:

2 an overlapping and segmenting unit for overlapping and segmenting an input signal
3 into overlapped-and-segmented input signals;

4 a FFT processor for performing fast Fourier transform on each overlapped-and-
5 segmented input signal to a segmented input frequency spectrum;

6 a perceptual sparse processing unit for removing high frequency components from
7 said segmented input frequency spectrum to form a segmented perceptual input
8 frequency spectrum;

9 a plurality of memory devices for storing a plurality of segmented response frequency
10 spectra;

11 a plurality of buffers for buffering a plurality of said segmented perceptual input
12 frequency spectra;

13 a plurality of multipliers for multiplying said buffered plurality of segmented
14 perceptual input frequency spectra with said plurality of segmented response
15 frequency spectra to form a plurality of segmented output frequency spectra;

16 a summation unit for adding said plurality of segmented output frequency spectra to
17 form an output frequency spectrum;

18 an IFFT processor for performing inverse fast Fourier transform on said output
19 frequency spectrum to form an output signal; and

20 a discarding unit for discarding a number of samples from said output signal to form a
21 final output signal;
22 wherein said perceptual sparse processing unit removes high frequency components
23 from said segmented input frequency spectrum based on a threshold.

1